ATLAS UVX QSO SURVEYS

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5 December 2011
Durham University

VST ATLAS Science Kick-Off meeting

ATLAS UVX QSO SURVEYS

- Science Goals
- Proposed 2dF QSO Dark Energy Survey (2QDES)
- $z < 2.2$ QSO candidate selection
- Summary

QSO Science goals

- **Cosmology Package**
  - Dark Energy evolution at z~1.5 via BAO in QSO clustering
  - Gravitational growth rate at z~1.5 via QSO RSD
  - Primordial non-Gaussianity via QSO Large-scale clustering
  - QSO Lensing (magnification bias) by foreground galaxies

- **Other Science**
  - QSO (AGN) -host galaxy evolution, i.e. galaxy formation feedback processes etc.
  - QSO-BH (halo) mass evolution via clustering and LF, e.g. Shanks et al. (2011)

Dark Energy evolution via BAO

- Nominal survey size for 3σ detection of BAO peak, 3% error in D_V; $85 deg^{-2}$ (i.e. 2SLAQ g < 21.85mag) over 3000 deg^2

Measuring BAO and non-Gaussianity via QSO clustering

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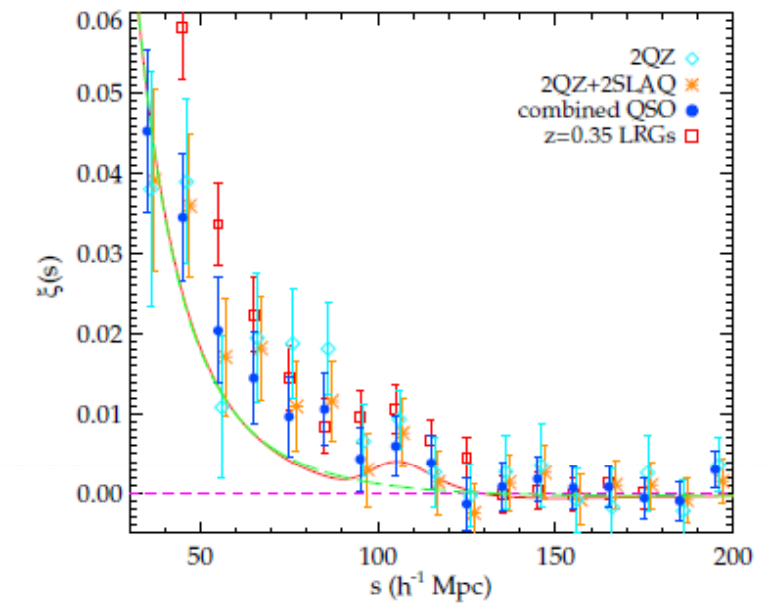
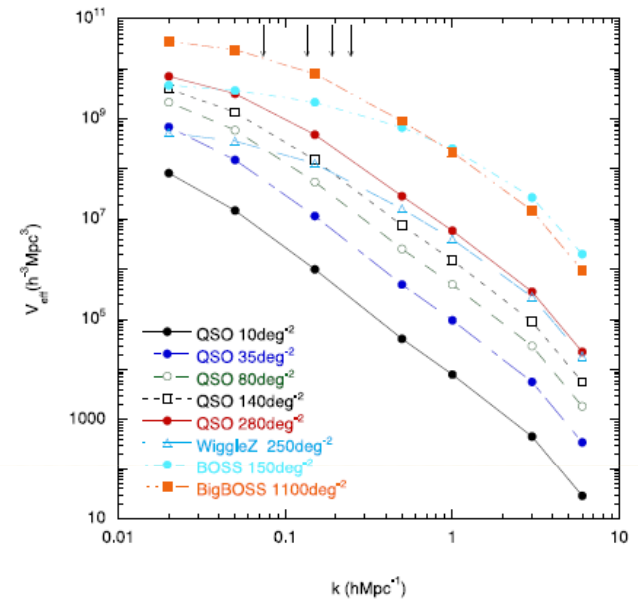
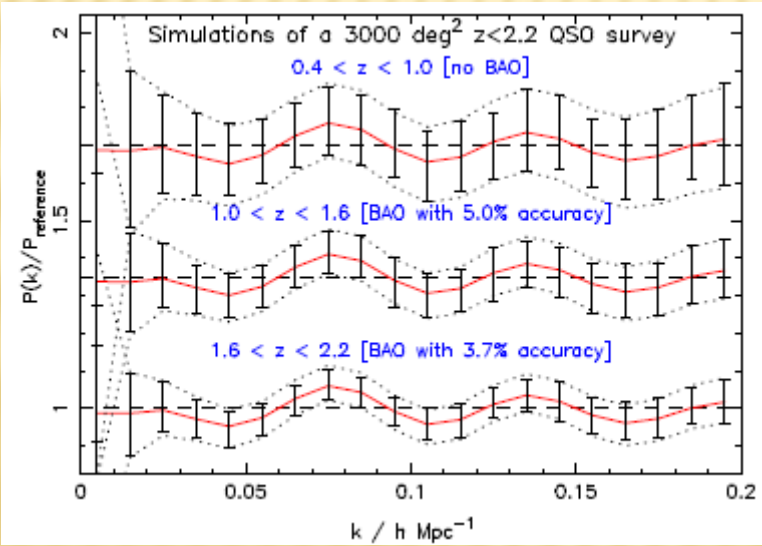
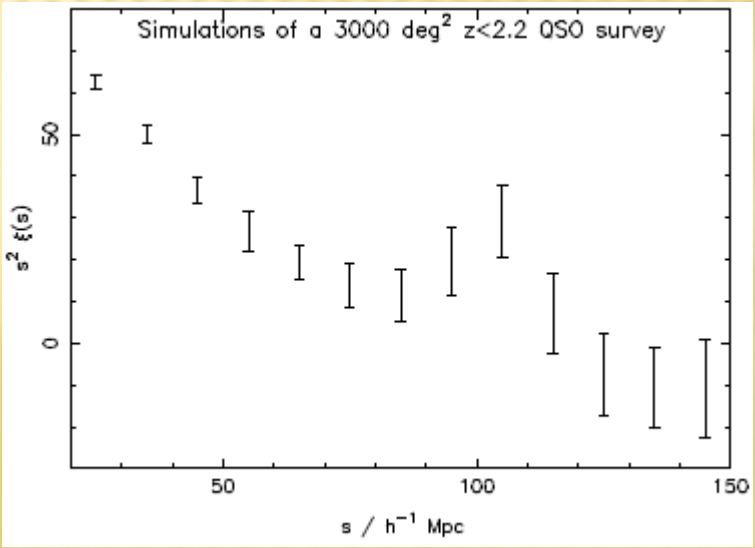
Dark Energy evolution via BAO

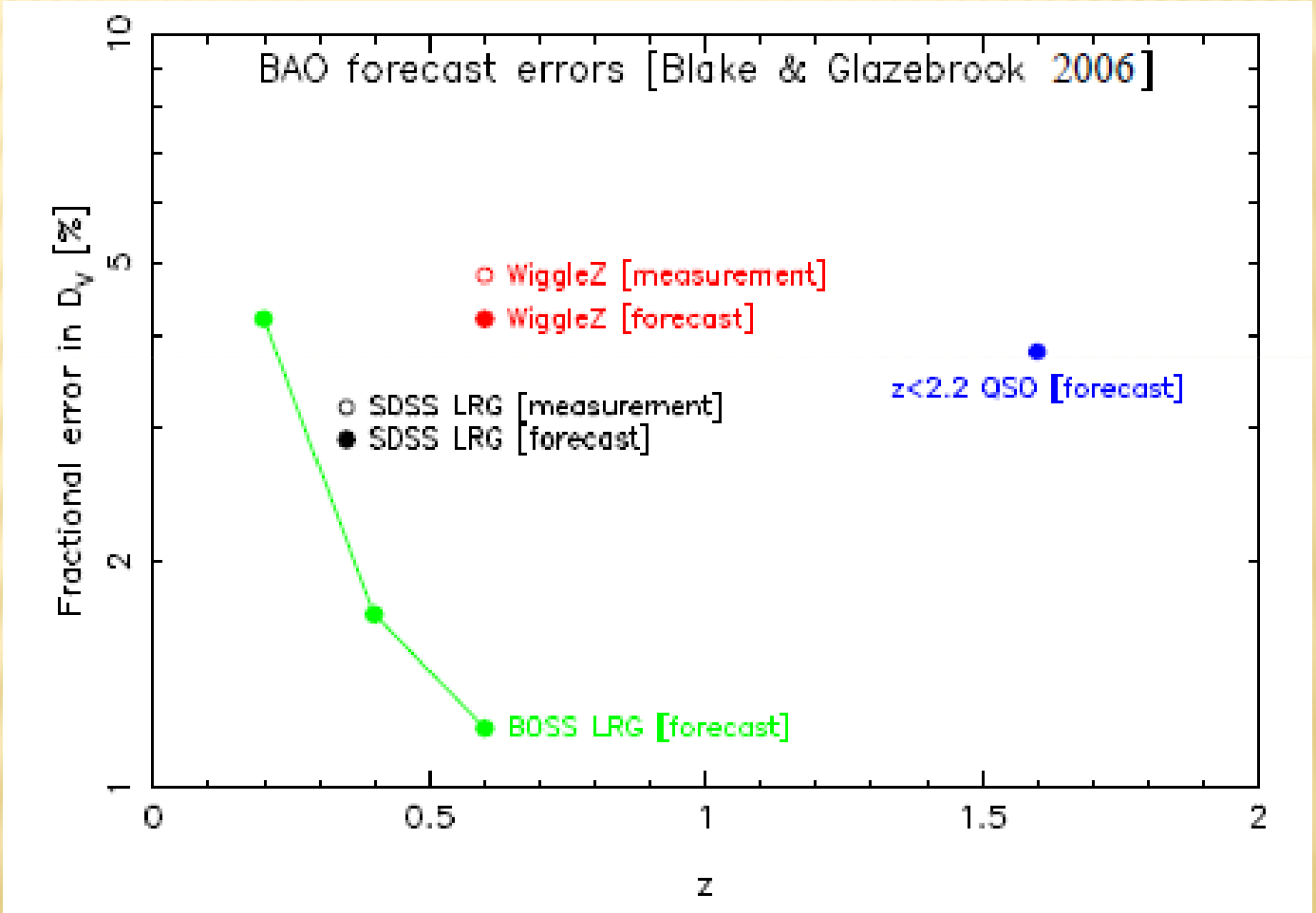






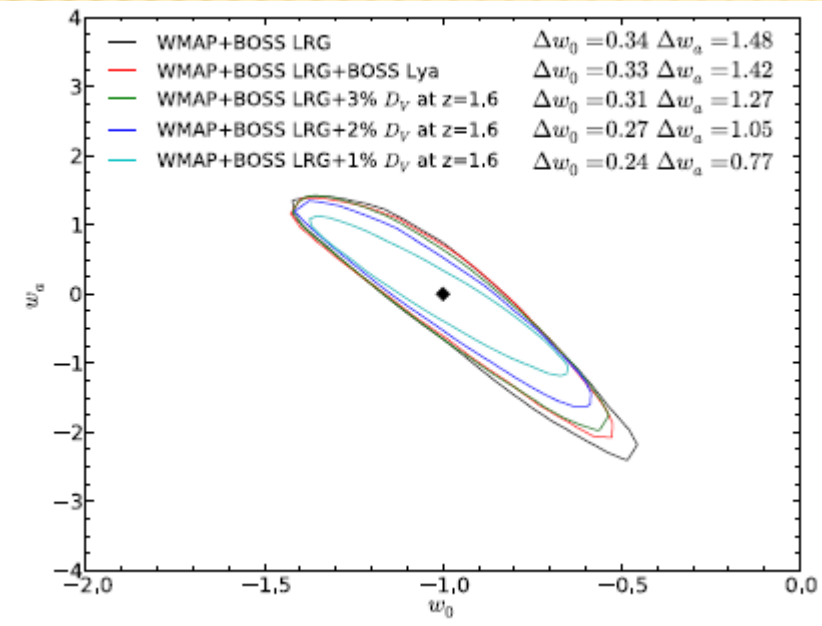


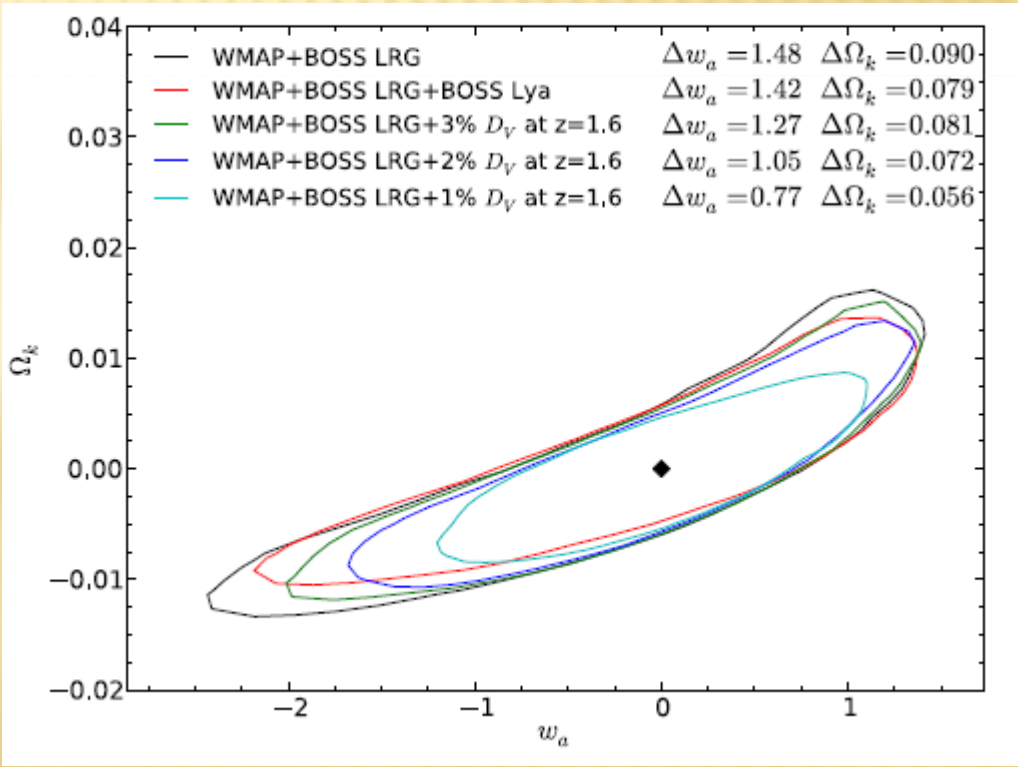
Dark Energy evolution via BAO



Dark Energy evolution via BAO

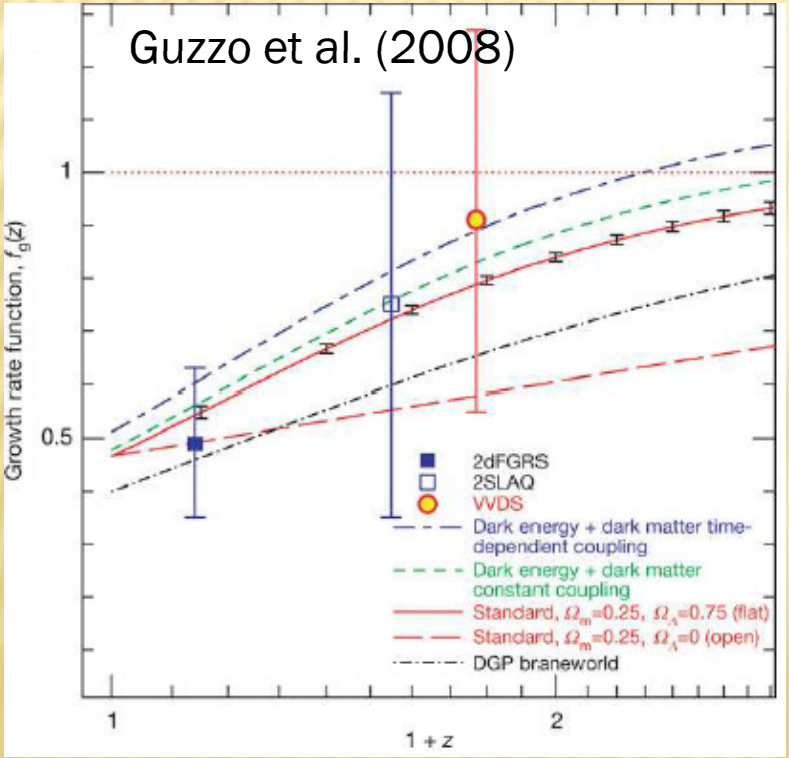
- 50% higher QSO density (i.e. g<22.5mag) and 50% bigger area ➡ 6σ BAO detection, ΔD_V =1.5% and 60% of BOSS error on dark energy evolution parameter, w_a
- $w(a)=w_0+w_a(1-a)$

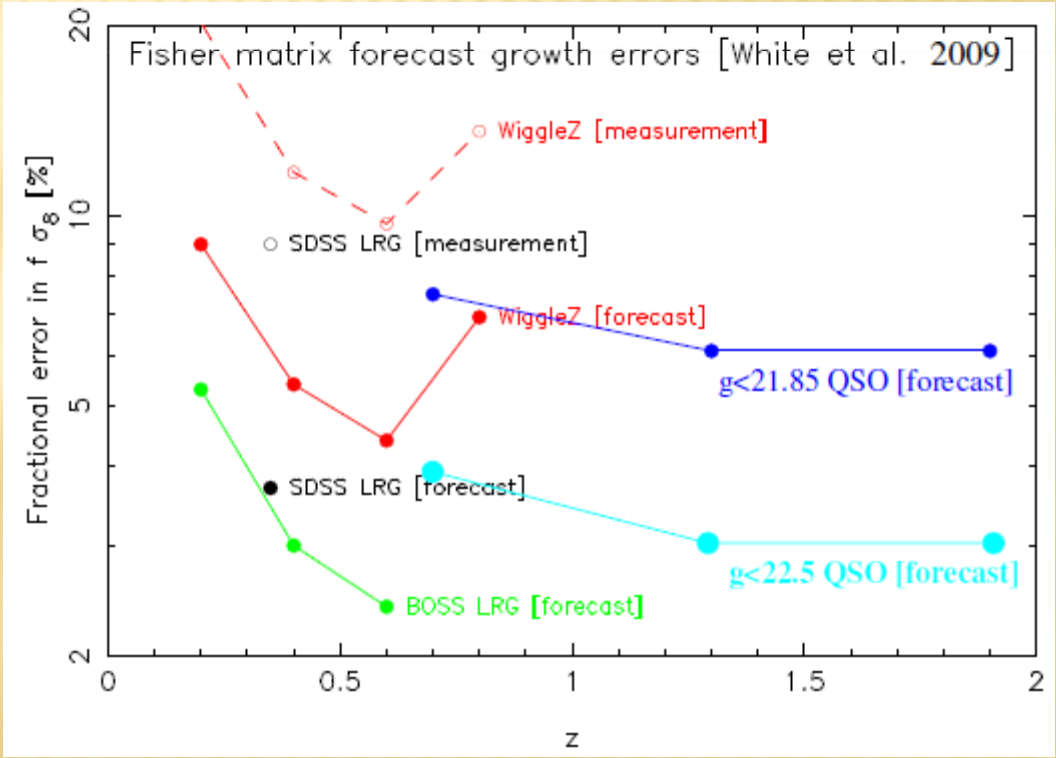




Redshift-Space Distortion

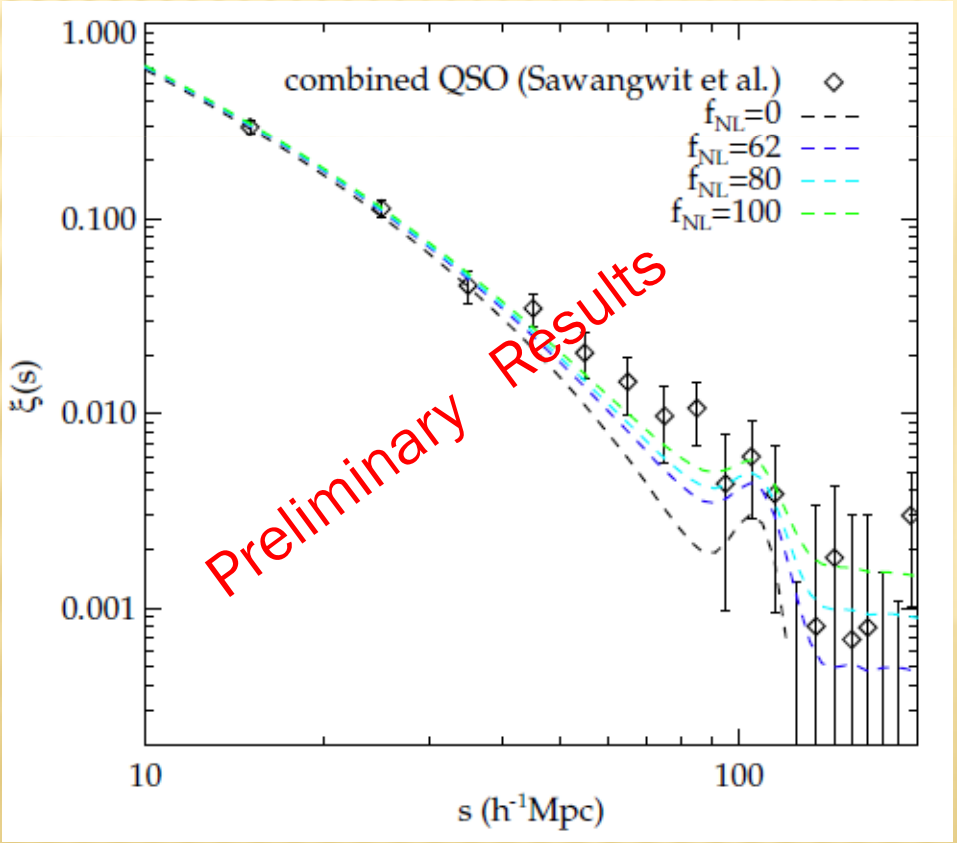
- Testing gravity model via growth rate, $f(z) \approx \Omega_m^{\gamma}(z)$ where γ is model dependent, e.g. $\gamma \approx 0.55$ for standard GR with LCDM
- Although $\Omega_m(z=1.5) \longrightarrow 1.0$, the measured $f\sigma_8$ still provide a vital "anchor" for low-redshift measurements

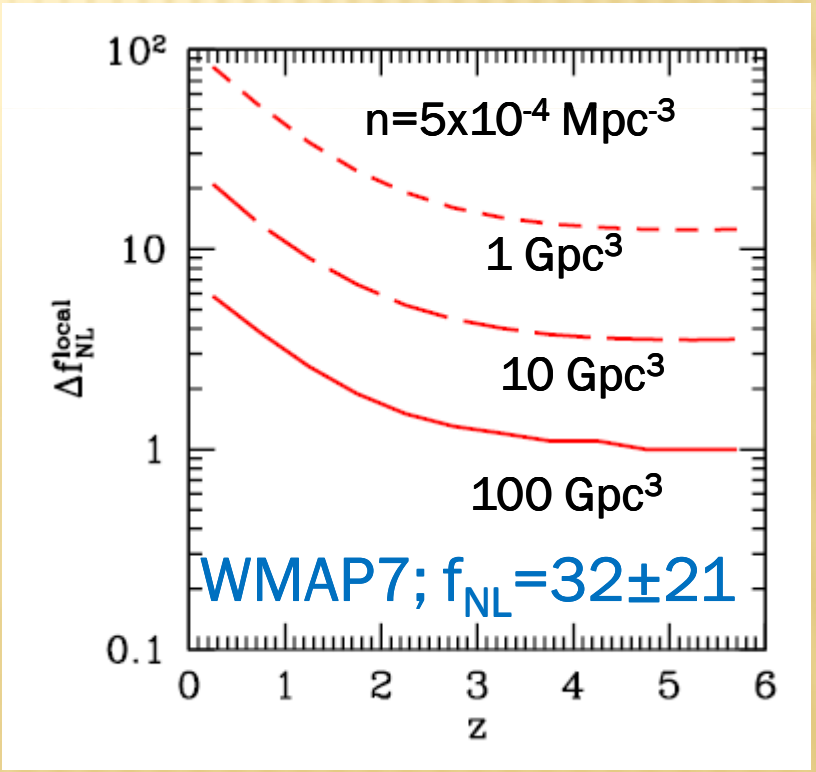




Primordial non-Gaussianity

- Primordial non-Gaussianity leads to scale-dependent bias at large scales, $b_{NG}(z,k) \alpha f_{NL} \times (b_G-1) \times (1+z) / k^2$
- For nominal survey ($n=2.5\times10^{-5}$ Mpc^{-3}, 30 Gpc^3), $\Delta f_{NL} \approx 15$

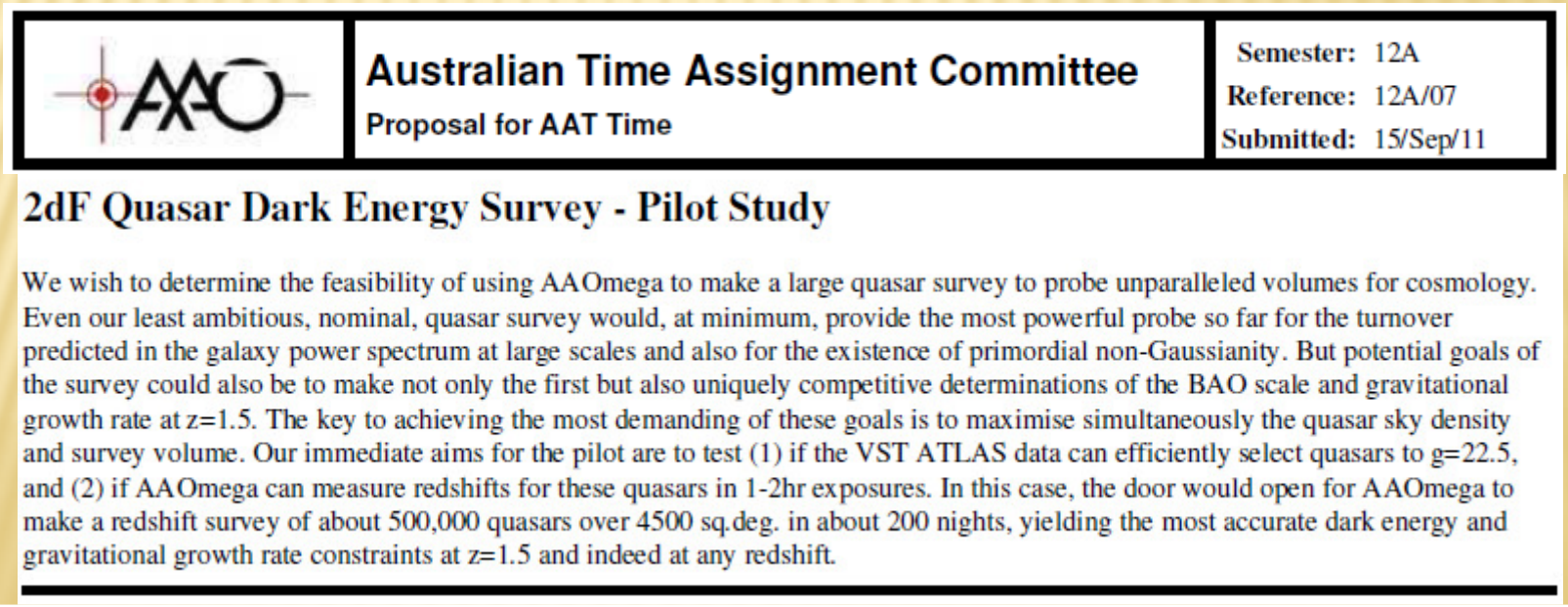




Sefusatti & Komatsu (2007)

Proposed 2dF QSO Dark Energy Survey (2QDES)

- Utilising AAT 2dF+AAOmega plus VST ATLAS in the southern sky
- Fibre density ≈110deg^{-2}, "sweet spot" for our proposed QSO survey to g < 21.85 (22.5 TBC)
- Using AAOmega ETC, 50Å broad emission line can be detected at ≈11σ in 60-90min exposure for g=22.5 QSO, i.e. 500,000 QSOs over 4500deg^2 in ≈200 nights, need pilot study to confirm



Australian Time Assignment Committee
Proposal for AAT Time

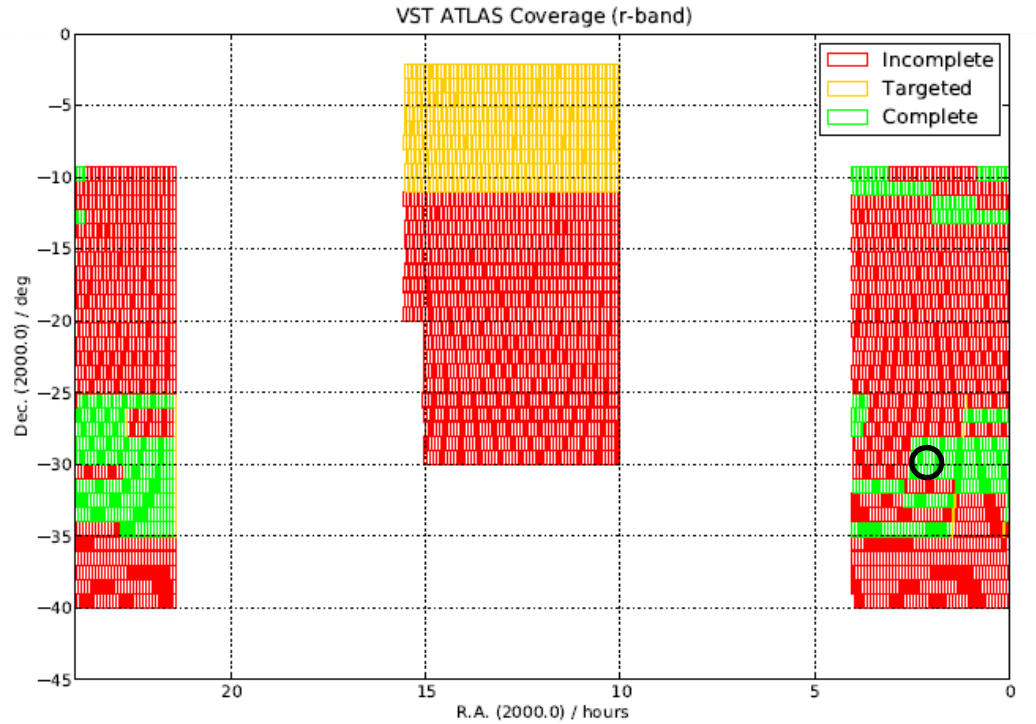
Semester: 12A
Reference: 12A/07
Submitted: 15/Sep/11

2dF Quasar Dark Energy Survey - Pilot Study

We wish to determine the feasibility of using AAOmega to make a large quasar survey to probe unparalleled volumes for cosmology. Even our least ambitious, nominal, quasar survey would, at minimum, provide the most powerful probe so far for the turnover predicted in the galaxy power spectrum at large scales and also for the existence of primordial non-Gaussianity. But potential goals of the survey could also be to make not only the first but also uniquely competitive determinations of the BAO scale and gravitational growth rate at z=1.5. The key to achieving the most demanding of these goals is to maximise simultaneously the quasar sky density and survey volume. Our immediate aims for the pilot are to test (1) if the VST ATLAS data can efficiently select quasars to g=22.5, and (2) if AAOmega can measure redshifts for these quasars in 1-2hr exposures. In this case, the door would open for AAOmega to make a redshift survey of about 500,000 quasars over 4500 sq.deg. in about 200 nights, yielding the most accurate dark energy and gravitational growth rate constraints at z=1.5 and indeed at any redshift.

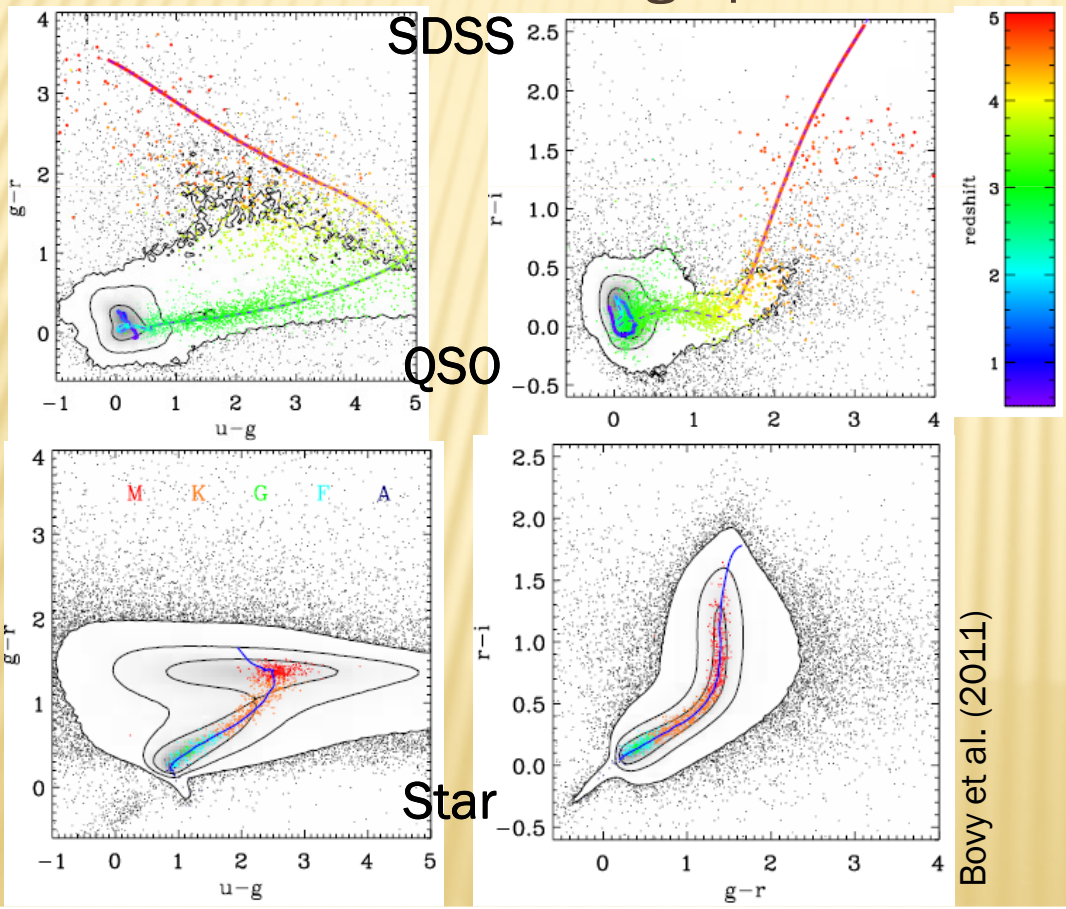
2QDES-Pilot study

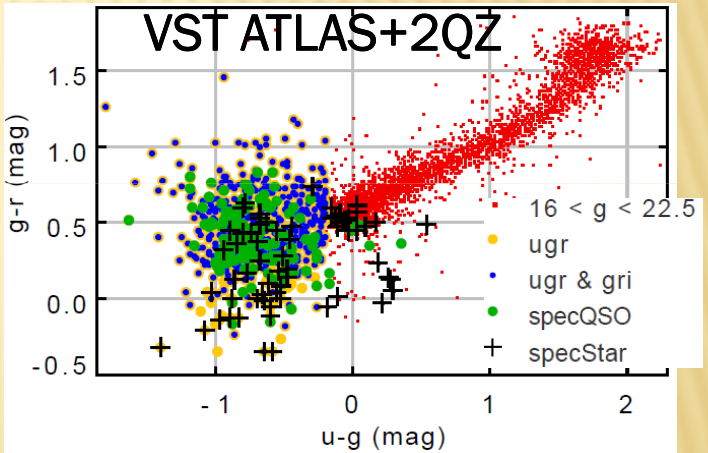
- PI. Michael Drinkwater, CoI. T.Shanks, U. Sawangwit, S. Croom, D. Parkinson, K. Glazebrook, R. Jurek and S. Wyithe
- 3 nights allocated in April 2012
- Also 4.5hr service time, coming up on 16 Dec, 2h30-30:00

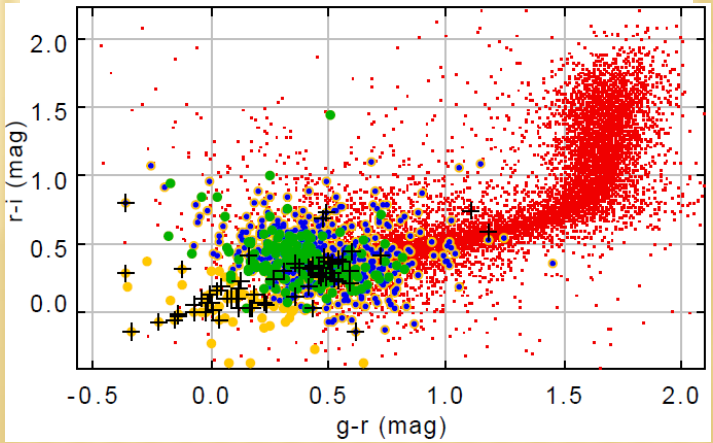


z<2.2 QSO Candidate selection

- Using traditional ugr and gri colour-colour
- Also Bovy et al. (2011), XDQSO using flux-flux rather than colour-colour to assign prob. for the redshift of interest







z<2.2 QSO Candidate selection

- Using gri colour helps to get rid of stellar conta. considerably, $\approx 22\% \longrightarrow 12\%$, c.f. 40-50% for 2QZ and 2SLAQ
- For Bovy et al. algorithm, we still need to properly calibrate VST ATLAS flux to SDSS system, also “forced photometry” will be helpful
- Currently, our ugr & gri (and CASU star-galaxy separation) selects $\approx 120 \mathrm{deg}^{-2}$ $g<22.5$ candidates
- … still issues to consider, e.g. u-band detections/limits

END